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Abstract

This paper argues that the Feldstein and Horioka (1980) cross country correlations and observed time series correlations between national saving and domestic investment may be a consequence of government spending patterns. I analyze the effects of government consumption in an intertemporal equilibrium model with both tradable and nontradable goods. When government consumption falls largely on nontradables the model's predictions are consistent with a number of empirical observations in OECD countries.

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1 Introduction

A number of empirical studies find a strong positive cross country correlation between long-term national saving rates and domestic investment rates of the industrialized countries in the OECD. The strong intracountry correlation is a puzzle that many economists have tried to solve in the past decade. If a country can borrow and lend in international capital markets, why should domestic sources of funds seem to matter so much for its investment? What makes the puzzle especially vexing is the apparent high degree of short term capital mobility, which suggests that savings should be allocated efficiently among world investment opportunities.

The reason for the correlation between domestic sources and uses of funds has important implications for theory and policy. Some economists use the pattern as a convenient excuse for making closed economy assumptions. Bacchetta and Feldstein (1989), for example, have appealed to the pattern to buttress arguments in favor of domestic tax policies to stimulate saving. If a country is effectively closed, they argue, tax advantages for saving will boost future domestic productivity. Despite the importance of the saving-investment correlations, we currently know little about why they exist. These patterns, first noted by Feldstein and Horioka (1980) (FH), have prompted numerous explanations, none of which is entirely satisfactory.

Feldstein and Horioka's initial interpretation, that the evidence is inconsistent with freely mobile capital, is dubious. For example, Obstfeld (1986) develops a life cycle model which, when simulated, yields regression results similar to those found by FH. In his model capital is freely mobile but economic growth determines both saving and investment, leading them to be highly correlated. Summers (1986), however, finds that empirically growth is not the third factor responsible for the S-I association. Instead, he and others (Westphal (1983), Tobin (1983), Fieleke (1982)) suggest that governments deliberately target the current account through monetary and fiscal policies designed to eliminate sizable imbalances. This rationale, however, fails to explain why governments in different countries would choose so consistently to restrict current accounts, which simply reflect intertemporal trade.

Bovenberg (1989) demonstrates that if goods are imperfect substitutes in consumption, domestic investment incentives can cause changes in welfare and interest rates that stimulate savings, even if financial capital is perfectly mobile. Although his 2-country model rationalizes a close time series link between saving and investment for countries that affect world commodity prices, it does little to clear up the puzzle for small countries.

A further promising line of research is Frankel's suggestion (1986) that the close saving-investment association is the result of imperfect integration of goods markets rather than financial markets. Consumption and investment depend on real interest rates but real interest rate parity fails when some goods are not traded and can result in crowding out. In fact, empirical tests have generally provided evidence against the hypothesis of real interest parity, which suggests that international commodity markets are not perfectly integrated (for example, Mishkin (1984), Cumby and Mishkin (1986)). Work by Murphy (1986), Engel and Kletzer (1989) and Wong (1990) have all showed that the existence of nontraded commodities can give rise to a saving-investment link. However, it remains to be determined what is responsible for the cross country differences in saving and investment behavior and what is the source of shocks - technological, monetary, fiscal - that gives rise to their comovements over time. Real business cycle models have emphasized highly persistent productivity shocks as a possible candidate (see Baxter and Crucini (1990), Finn (1990), Cardia (1991)).

In this paper I argue that government consumption is an important common factor determining saving and investment rates and may be responsible for both the cross sectional correlations and observed time series behavior. I construct a theoretical model of a small open economy that demonstrates how public spending affects investment, saving and current account rates when the country can borrow and lend freely with the rest of the world and compare model predictions with observed data. Because government consumption falls primarily on nontradables, I incorporate Frankel's idea that imperfect integration of goods markets, not financial capital markets, is important to understand the saving-investment link.

The framework is an intertemporal equilibrium model with both tradable and nontradable goods. Output, saving and investment decisions are derived from optimizing behavior, while government behavior is exogenous. I modify models developed in Dornbusch (1983), Bovenberg (1986) and Frenkel and Razin (1986a,b). In contrast to Frenkel and Razin or Dornbusch, investment and output are endogenous so we can explore the interaction between capital accumulation and consumption. Bovenberg incorporates endogenous investment but analyzes a model with two large countries, while here I consider a small country that cannot affect world prices.

The paper is organized as follows: Section II compiles a list of empirical observations using an updated data set. Section III presents a two period model to analyze how the time pattern and composition of government consumption affect household consumption and domestic capital accumulation. In section IV the model is extended to the infinite horizon case and I show conditions under which cross country differences in longrun government consumption give rise to differences in steady state saving and investment rates. The existence of a nontraded goods sector is critical in generating this result. Conclusions appear in section V.

2 Data Analysis

The data employed are annual observations from OECD National Income Accounts and cover the years 1965-1985 for 24 countries. Savings is calculated as a residual, gross national product minus private and government consumption. Investment is measured as gross fixed capital formation plus the change in stocks. In computing correlations, all variables are expressed as a fraction of gross domestic product to avoid nonstationarity problems . Table 1 reports contemporaneous time series correlations. Table 2 provides one long run average observation for each country of national saving (S), gross domestic investment (I) and current account rates (BCA). Also included are BCA/S and -BCA/I which are, respectively, the average proportion of national saving accounted for by capital outflows and the average proportion of domestic investment accounted for by capital inflows. Table 3 reports sample correlation matrices of means and standard deviations for these variables. I summarize the content of these tables into two groups of observations.

TIME SERIES OBSERVATIONS

Fact 1: For many countries the contemporaneous time series correlation between national saving and domestic investment rates is positive.

Although most countries have positive correlations, there is considerable heterogeneity across countries regarding the magnitude of the association and the correlations are usually quite far from the value of 1 implied by complete capital immobility. For some economies divergences between saving and investment have at times exceeded 10 percent of GDP.

The last 4 columns of Table 1 report contemporaneous correlations between government consumption rates and private consumption rates, saving rates and the two components of saving rates: investment and current account rates. For 16 of the 24 countries there is a negative relationship between government and private consumption rates. Noticeable exceptions are the four largest economies, U.S., Japan, West Germany and France. In all cases we observe:

Fact 2: Within individual countries there exists a negative contemporaneous time series correlation between government consumption rates and saving rates.

There is wider variation regarding the association between government consumption and the two components of saving but in most countries government consumption and investment rates also move in opposite directions.

CROSS SECTION OBSERVATIONS

Fact 3: Average national saving rates and average domestic investment rates are positively correlated.

The correlation between average saving and investment rates is positive, but has fallen relative to the original Feldstein-Horioka findings of 0.88.

Fact 4: For countries with high average saving rates, the difference between average saving and investment rates is high.

Fact 5: For countries with high average saving rates, a higher fraction of saving flows abroad.

Fact 6: Countries with more highly variable saving rates also have more highly variable investment and current account rates.

An analysis of the variance of the pooled saving rate series (21x23 observations since Luxembourg is omitted), however, establishes that there is much more variation across individual countries than there is across time. The following decomposition of the series $(\frac{S}{Y})_{it}$ is used:

$$(\frac{S}{Y})_{it} = \nu_i + \eta_t + \varepsilon_{it} \quad i = 1, ...23, \quad t = 1, ...21 \qquad (1)$$

where ν_i is the country effect, η_t is the time effect, and ε_{it} is the purely random effect. 70% of this series' total variation can be attributed to variation across countries, while only 15% is attributable to variation across time. In the pooled investment rate series, again there is more variation across countries than across time. 55% is accounted for by country effect and 14% by time effects. This suggests that there is some underlying long run difference in the structure of national economies.

Given the earlier time series findings, differences in long run average government consumption emerge as a plausible candidate responsible for the cross country differences in long run investment and saving rates. There is a negative correlation, -0.43, between average government expenditure rates and average domestic investment rates, significant at a 95% confidence level. The correlation between government expenditure and saving rates is also negative but different from zero only at an 80% confidence level using a two tailed t-test.

Having reexamined relationships among saving, investment and current account rates in OECD countries, I suggest that although both cross section and time series S-I correlations are positive, this need not to be the consequence of low capital mobility. In fact, it should be noted that even with perfect capital mobility we should not be surprised to observe a high positive cross sectional correlation between saving and investment rates when they are averaged over very long periods of time. Since the current account, which reflects intertemporal trade, is equal to the change in a country's net external indebtedness, these changes must cumulate to zero over time unless the country defaults on its loans (or, if it is a net lender, is willing never to be paid back). Moreover, for many economies time series correlations between saving and investment rates are substantially different from the value of 1 implied by complete capital immobility. Countries such as Ireland, New Zealand, Denmark and Greece have run large current account deficits for periods of time exceeding a decade.

Based on the above empirical observations, instead I suggest that government consumption may be an important common factor determining both saving rate and investment rates. In the next section I construct a structural model that demonstrates the effects of government consumption patterns on capital accumulation and household saving. The descriptive statistics compiled above provide a set of empirical regularities with which I can compare the predictions of the artificial economy for consistency.

3 The Model

The economy lasts for two periods. Agents are all identical and have preferences over two goods, a tradable and a nontradable. In the first period agents receive an endowment of each of the two goods and decide how much to consume and how much to save to augment second period consumption. The goods are perishable but savings can be done either through lending to domestic firms or to the rest of the world in the form of a freely traded bond. The country is small in the markets for tradable goods and internationally traded bonds. The relative price of period t nontradable goods in terms of period t tradable goods (the real exchange rate) is given by $P_t, \quad t = 1, 2$. The world rate of interest is fixed in terms of tradable goods and denoted by r. The home country can borrow or lend unlimited amounts at the rate r, subject to the intertemporal trade balance constraint.

3.1 Production

During the first period firms in either sector can borrow to invest in new capital which will become productive the following period. We assume that the investment good is nontradable. Unlike other models in which the investment good is tradable (see for example Zeira (1987), Bovenberg (1989), Wong (1990), Cardia (1991)), this assumption makes clear the distinction between financial capital mobility and physical capital mobility. While clearly a simplification, it is motivated by the observation that a large part of investment is in the form of home goods such as transportation systems, schools to develop human capital and buildings, rather than just transportable machinery. For example, in 1980 in the U.S. residential and nonresidential building plus land improvement alone accounted for 56% of gross fixed capital formation. In the second period the capital is combined with labor to produce tradable and nontradable goods. Domestic output of each good is produced with a constant returns to scale production function according to:

$$Y_T = G(K_T, L_T) = L_T g(k_T) \tag{2}$$

$$Y_N = F(K_N, L_N) = L_N f(k_N) \tag{3}$$

where $k_T = \frac{K_T}{L_T}$ is the capital-labor ratio in the tradable goods sector and k_N is the capital-labor ratio in the nontradable goods sector. It is assumed that $\frac{dg(.)}{dk_T} = \frac{\delta G(.)}{\delta K_T} > 0$ and $\frac{d^2 g(.)}{dk_T^2} < 0$. Similar assumptions are made for the technology of the nontradable sector. While labor is freely mobile between the two sectors, total labor supply is fixed and equal to L so that $L_N + L_K = L$.

Firms choose inputs to maximize profits:

$$\begin{aligned} Max\ \Pi_N &= P_2 F(K_N, L_N) - wL_N - P_1(1+r)K_N & (4) \\ Max\ \Pi_T &= G(K_T, LT) - wL_T - P_1(1+r)K_T & (5) \end{aligned}$$

Optimality of firms' decisions requires that labor adjusts until the value of the marginal product in terms of tradable goods is the same in each industry and that investment takes place in each industry until the marginal products equal the marginal cost of capital.

3.2 Government

The government exogenously consumes an amount G_{Nt} of nontradables and G_{Tt} of tradables in period t which it finances through lump sum taxation Z_t of households in the period it is consumed. Since the analysis is purely positive, there is no explicit government objective and we require only that the government satisfy its period budget constraint:

$$P_t G_{Nt} + G_{Tt} \leq Z_t \tag{6}$$

3.3 Household Preferences

The representative household consumes tradables and nontradables which are imperfect substitutes. Instantaneous utility has the functional form:

$$\begin{aligned} U &= \frac{1}{1-\gamma} C_t^{1-\gamma} \\ C_t &= C_{Nt}^{\alpha} C_{Tt}^{(1-\alpha)} \qquad 0<\alpha<1, \quad \gamma>0 \end{aligned} \tag{7}$$

Here $\frac{1}{\gamma}$ is the intertemporal elasticity of substitution. If $\frac{1}{\gamma}$ tends to infinity, $U(.)$ is nearly linear and consumers substitute consumption very easily over time. If $\frac{1}{\gamma}$ is close to zero, intertemporal substitutability is very low and agents smooth consumption.

Given expectations of taxes and prices, the representative household chooses consumption $(C_{N1}, C_{T1}, C_{N2}, C_{T2})$ and end of period bond holdings B to maximize discounted lifetime utility. Labor is supplied inelastically in the second period at the wage w.

$$Max \quad V = U(C_{N1}, C_{T1}) + \beta U(C_{N2}, C_{T2}) \tag{8}$$

subject to

$$P_1 C_{N1} + C_{T1} + B \leq P_1 E_{N1} + E_{T1} - Z_1 \tag{9}$$

$$P_2 C_{N2} + C_{T2} \leq (1+r)B + wL - Z_2 \tag{10}$$

Combining the constraints we get the agent's intertemporal budget constraint:

$$P_2 C_{N2} + C_{T2} \leq wL - Z_2 + (1+r)(P_1 E_1 + E_{T1} - Z_1 - P_1 C_{N1} - C_{T1}) \tag{11}$$

Intertemporal optimality for the household problem requires that:

$$\frac{U_{C1}}{\beta U_{C2}} = (1+r)(\frac{P_1}{P_2})^{\alpha} \tag{12}$$

where C_t is composite consumption at time t. The right hand side term of equation (12) is the domestic real rate of interest measured in terms of the domestic consumption basket. It will differ from the exogenously given world rate of return if the relative price of nontradables changes over time. With the above functional form for the utility function, equation (12) can be inverted to solve for the households' optimal consumption profile:

$$\frac{C_1}{C_2} = [\beta(1+r)(\frac{P_1}{P_2})^{\alpha}]^{\frac{-1}{\gamma}} \tag{13}$$

The degree to which variations in the relative price of nontradables affect the consumption profile depends on α, the share of nontradable good expenditures in total consumption expenditures. Changes in the relative price of nontradables are more important when they compose a large proportion of total consumption spending. The effect of price variations also depends on $\frac{1}{\gamma}$, which determines how consumers adjust consumption over time in response to real interest rate changes.

3.4 Equilibrium

Let Z be the vector of taxes $Z = (Z_1, Z_2)$. A perfect foresight equilibrium is given by a vector of prices $P^* = (P_1^*, P_2^*, w^*)$, consumption allocations $C^* = (C_{N1}^*, C_{N2}^*, C_{T1}^*, C_{T2}^*)$, bond holdings B^* and domestic resource allocations $A^* = (L_N^*, L_T^*, K_N^*, K_T^*)$ such that, given their expectations of P, Z, and r

(i) households choose consumption $C^* = C(P, Z, r)$ and bond holdings $B^* = B(P, Z, r)$ to maximize discounted lifetime utility subject to their budget constraint.

(ii) firms choose resource allocations $A^* = A(P, Z, r)$ to maximize profits

(iii) The labor market clears: $L_N^* + L_T^* = L$

(iv) The market for nontradables clears each period:

$$C_{N1}^* + K_N^* + K_T^* + G_{N1} = E_{N1}$$

$$C_{N2}^* + G_{N2} = F(K_N^*, L_N^*)$$

(v) The government budget constraint is satisfied

and market clearing prices equal the expected prices that underlie agents' decisions.

3.5 Solution

The equilibrium solution is determined by the household's and firm's first order conditions and conditions (iii)-(v) above. In order to calculate an explicit solution assume that the production functions are Cobb-Douglas:

$$Y_T = K_T^v L_T^{(1-v)} \tag{14}$$

$$Y_N = K_N^q L_N^{(1-q)} \tag{15}$$

With these functional forms, equilibrium is determined by the solution to the following system of nonlinear equations:

$$\begin{aligned}
\frac{\alpha}{1-\alpha}\left(\frac{C_{T1}}{C_{N1}}\right) &= P_1 && (16)\\
\frac{\alpha}{1-\alpha}\left(\frac{C_{T2}}{C_{N2}}\right) &= P_2 && (17)\\
\left(\left(\frac{C_{N1}}{C_{N2}}\right)^{\alpha}\left(\frac{C_{T1}}{C_{T2}}\right)^{(1-\alpha)}\right)^{-\gamma} &= \beta(1+r)\left(\frac{P_1}{P_2}\right)^{\alpha} && (18)\\
P_2 q\left(\frac{K_N}{L_N}\right)^{(q-1)} &= (1+r)P_1 && (19)\\
v\left(\frac{K_T}{L_T}\right)^{(v-1)} &= (1+r)P_1 && (20)\\
P_2(1-q)\left(\frac{K_N}{L_N}\right)^{q} &= (1-v)\left(\frac{K_T}{L-L_N}\right)^{v} && (21)\\
C_{N1}+K_T+K_N+G_{N1} &= E_{N1} && (22)\\
C_{N2}+G_{N2} &= K_N^q L_N^{(1-q)} && (23)
\end{aligned}$$

$$(1+r)(E_{T1}-C_{T1}-G_{T1})-G_{T2}+K_T^v(L-L_N)^{(1-v)}-C_{T2}=0 \tag{24}$$

Since the system is nonlinear and no analytical solution exists a numerical procedure must be used. Here I employ the Newton-Ralphson method (see Press, et al. (1989)) to solve the system.

4 Government Consumption Expenditures

In a small economy if all goods are traded and the country can borrow freely, then investment decisions depend only on the exogenous world interest rate and domestic technology parameters, irrespective of household consumption or saving decisions (see Zeira (1987), Engel and Kletzer (1989)). However, with nontradable goods domestic production and investment necessarily depend on consumption of nontradables. Domestic government consumption will then affect domestic investment, both directly, and also indirectly through its impact on household consumption choices.

To identify the channels that government fiscal policies which affect saving can, in turn, affect investment I present several numerical examples of the above model. The focus here is on how the composition of current and anticipated future government consumption interacts with the equilibrium real interest rate to determine aggregate consumption, domestic capital accumulation and external indebtedness.

Tables 4 and 5 give equilibrium solutions for a reference model and solutions when I alter first period government consumption of nontradables, tradables and second period government consumption of nontradables, tradables consecutively. Essentially these are exercises in comparative dynamics where government consumption is increased in turn by 20% of the initial endowment. Rather than presenting results for a particular "realistic" parameterization, I consider three cases in order to assess the sensitivity of conclusions to model specification. The model has several free parameters: r, the exogenous world interest rate; q and v, capital's share in the production of nontradables and tradables, respectively; α, the household's share of nontradables in total consumption expenditures; β, the subjective discount factor; and γ, the curvature of the period utility function. The tables report results of two extreme cases regarding the intertemporal elasticity of substitution. In Table 4 $\gamma = 1000$ so agents always choose a completely flat consumption profile, regardless of the real interest rate. Table 5 reports solutions when $\gamma = 0$ so there is perfect substitutability of consumption over time.

For each of the two tables $\beta = \frac{1}{1+r} = 0.95$, which implies a real rate of 5.3% if we think of this as a compounded rate over, say, 30 years. Thus it is in line with the historical evidence in the U.S. (see Ibbotson and Sinquefeld (1978)). In case 1 production technologies are identical in each industry ($q = v = 0.3$), and households always spend half their consumption expenditures on tradables and half on nontradables ($\alpha = 0.5$). I interpret this as a benchmark case. In case 2 production technologies are the same as in case 1 but household consumption preferences are biased toward the nontradable good ($\alpha = 0.6$). In case 3 the production of the nontradable good is relatively more labor intensive than the tradable good ($q = 0.3, v = 0.4$).

A few comments to motivate these choices are in order. The range chosen for the share of capital in production is in line with historical cross country evidence as reported in Backus and Kehoe (1989). Much direct evidence on the relative factor intensities of the tradable and nontradable sectors is difficult to obtain but published OECD Industrial Structure statistics for Norway and Sweden lend support to the idea that nontradables are more labor intensive. [1] Among the OECD countries, the share of nontradables in total household consumption spending ranges from a low of .469 for the US to a high of .753 for Portugal [2].

Government consumption expenditure affects household consumption patterns through two channels. First, a higher level of government spending in either period lowers private agents' disposable income so there is a wealth effect; second, unless the gov-

[1] For both countries fabricated metal products (ISIC 38) and chemical products (ISIC 35) account for the largest shares of imported goods. In 1982 the ratio of wages and salaries of employees to total production of fabricated metal products was .27 for Norway and .34 for Sweden. The same ratio for chemical products was .11 for Norway and .15 for Sweden. These ratios for the most highly traded goods can be compared to the ratio of wages and salaries to total production in the services sector (ISIC 6.90); .36 for Norway and .46 for Sweden.

[2] I calculate this variable explicitly for each country by dividing final consumption expenditure of resident households into 2 groups. Included in the category for tradable goods are: food,beverages, and tobacco; clothing and footwear; fuel and power; furniture, furnishings and household equipment; transport and communication; and net purchases abroad by resident households. Included in the category for nontradables are: medical care and health expenses; gross rent; recreational, entertainment, education and cultural services; personal care; and expenditures in restaurants, cafes and hotels.

ernment's propensity to spend on nontradables is identical to the household's, higher public spending in one period alters the relative price of nontradables in terms of tradables in that period. This change in intratemporal prices alters the consumption based real rate of return and can cause household's to tilt consumption towards either the current or future period (see Razin (1984) or Frankel and Razin (1987)). The extent households tilt their consumption profile depends on the intertemporal elasticity of substitution.

4.1 Increasing Current Government Consumption of Nontradables

First consider the case when households completely smooth consumption (Table 4). A temporary rise in current government nontradables consumption causes both saving and investment rates to fall, while the current account can either rise or fall. The mechanism producing this result is as follows. Higher current government nontradables demand both increases the current relative price of nontradables and lowers current household disposable income. With lower income current private nontradables demand falls, but not enough to offset a rise in P_1 because part of the reduction in income is shifted to the future. Since aggregate current consumption rises while current output remains the same, the national saving rate decreases. Moreover, the rise in P_1 raises the marginal cost of capital in both sectors and aggregate investment falls. Thus, relative to the initial equilibrium, both national saving and domestic investment rates fall. The current account response depends on the relative strengths of two opposing effects. The drop in household income reduces current tradables demand but the higher current relative price of nontradables, a substitute good, raises household tradables demand.

Now consider the other extreme when households make no attempt to smooth consumption, but rather alter their consumption profiles greatly in response to even small changes in the real interest rate (Table 5). In this case a transitory increase in current government nontradables consumption causes saving and current account rates to rise, while the investment rate response depends on the two sectors' relative factor intensities.

Higher current government nontradables demand would, ceteris paribus, raise P_1, thus raising the real interest rate. But since household consumption is perfectly responsive to interest rate movements, consumers tilt consumption towards the future. The resulting decline in current nontradables demand puts downward pressure on P_1, and the rise in future demand puts upward pressure on P_2 so that in the new equilibrium (as in the original) relative prices are equalized across time.

When households do not smooth we get the rather perverse result that although current household income falls, rather than spreading the requisite reduction in consumption across both periods, households actually increase second period consumption (see Dornbusch (1986)). This higher future consumption directly increases future nontradables consumption so more resources must be employed in their production. Capital and labor flow out of the tradable sector. The new equilibrium is characterized by lower investment in the tradable sector and higher in the nontradable sector. If the relative factor intensities are identical, aggregate investment remains unchanged. But if the nontradable sector is more labor intensive, investment in that sector rises by a proportionately smaller amount than the decrease in the tradable sector. Thus, aggregate investment falls (in Table 5 compare column 2 with column 1 when $v > q$).

Therefore, if households are not concerned with smoothing, higher current government nontradables consumption tilts household consumption towards the future. Since first period aggregate consumption falls while supplies remain fixed, the equilibrium saving rate rises. Aggregate investment rises, falls or remains unchanged depending on whether the capital intensity of the nontradable sector is respectively higher, lower or the same as the tradable sector. The current account unambiguously improves since lower current household consumption reduces current tradables consumption while the supply remains fixed.

4.2 Increasing Future Government Consumption of Nontradables

Suppose agents currently learn that future government nontradables consumption will be high. If households smooth, then saving, investment and current account rates all rise. The expectation of lower future household income reduces, not only future consumption, but also current consumption. Current nontradables demand drops and P_1 falls, with the decrease greater the greater is the share of nontradables in total consumption demand. This drop in P_1 lowers the home real interest rate and decreases the marginal cost of capital in both sectors so aggregate investment rises. The country's net external indebtedness decreases since present tradables consumption falls in response to both household smoothing and the lower relative price of nontradables, while present supply remains fixed.

4.3 Discussion

While the discussion above focused on situations when government consumption fell exclusively on nontradables, similar reasoning can be used to analyze equilibrium responses to an increase in government consumption of traded goods. Table 6 summarizes both the results of the preceding analysis and the effects of an increase in government tradables consumption.

We conclude this section by comparing model predictions with observed time series behavior of government consumption, saving, investment and current account rates. The two period deterministic model provided a minimal framework necessary for a dynamic analysis but is clearly insufficient to provide explicit time series stochastic correlations. It is, however, useful in making qualitative statements regarding contemporaneous comovements among variables. From Table 6 we know these comovements depend crucially on the intertemporal elasticity of substitution and the composition of government expenditures. Clearly the extreme case of perfect substitutability over time is inappropriate. Although empirical estimates of $\frac{1}{\gamma}$ vary, most studies indicate a high degree of consumption smoothing (see Hall 1989). In 1980 in the U.S. government final expenditures on nontradables including education, health, social security and welfare (not including transfers), housing and community ammenities, recreational, cultural and religious affairs, economic services and general public services accounted for 66% of total final government expenditure. Remaining expenditures were largely on defense. So the most relevant case appears to be the one with low $\frac{1}{\gamma}$ where government consumption falls primarily on nontradables. Table 7 reports the theoretical correlations for this case and the actual contemporaneous correlations.

The empirical investigation of section 2 showed that for all countries (excluding Luxembourg) saving and investment rates are positively contemporaneously correlated and saving and government consumption rates are negatively contemporaneously correlated. The majority of countries also have negative correlations between $\frac{GOV_t}{Y_t}$ and $\frac{I_t}{Y_t}$ and between $\frac{GOV_t}{Y_t}$ and $\frac{BCA_t}{Y_t}$. Under the assumption that the elasticity of substitution between current and future consumption is low, if government consumption is heavily weighted with nontradables, the model generates a positive contemporaneous correlation between saving and investment rates and a negative contemporaneous correlation between government consumption and saving rates and government consumption and investment rates. Model predictions concerning the correlation between current account rate and other variables are not unambiguous, but will in general depend on the relative magnitudes of all preference and technology parameters.

Thus, with economically plausible parameter values, the theoretical framework provides qualitative predictions broadly consistent with observed time series correlations between saving and investment rates and correlations between government expenditure with savings and its two components.

5 Government Consumption and Long Run Saving and Investment

This section considers an infinite horizon version of the model of section 3 and examines how government consumption affects long run saving and investment rates.

In economies with only tradable goods cross country differences in government consumption financed by lump sum taxation do not lead to national differences in steady state investment and saving rates. Since each country is small, it does not affect world prices so government consumption does not alter domestic resource allocations. The effect of any level of permanent government consumption (regardless of composition) is simply to reduce private disposable income and consumption.

With nontradable goods, if the government's propensity to consume nontradables differs from the household's, relative prices and therefore the resource allocation will be affected. Resource allocation is in general important in determining long run aggregate domestic investment. Only when factor intensities in the two sectors are identical is aggregate investment unaffected. Therefore, cross country differences in government consumption requirements can give rise to cross country differences in long run investment rates. Further, under the widely accepted assumption that the nontradable sector is relatively more labor intensive, government consumption and long run investment are negatively correlated (see footnote 1).

We retain the assumption that the investment good is nontradable. The result that government consumption affects long run investment and saving does not depend on this but the sign and magnitude of the correlations do. I ignore the possibly different identities of agents who make saving and investment decisions and solve directly for the optimal individual consumption plan subject to resource constraints and government consumption requirements. Since there are no distortions in the economy, this results in the same resource allocation as the competitive equilibrium.

The optimal planner solves:

$$Max \quad \sum_{t=0}^{\infty} U(C_{Nt}, C_{Tt}) \tag{25}$$

subject to:

$$\begin{aligned} C_{Nt} + G_{Nt} + I_{Nt} + I_{Tt} &\leq F(K_{Nt}, L_{Nt}) \qquad t = 0, \infty & (26) \\ L_{Nt} + L_{Tt} &= L & (27) \\ K_{Nt+1} &= (1-\delta)K_{Nt} + I_{Nt} & (28) \\ K_{Tt+1} &= (1-\delta)K_{Tt} + I_{Tt} & (29) \end{aligned}$$

and the intertemporal trade balance constraint

$$\sum_{t=0}^{\infty} (\frac{1}{1+r})^t (C_{Tt} + G_{Tt}) \leq \sum_{t=0}^{\infty} (\frac{1}{1+r})^t G(K_{Tt}, L_{Tt}) - (-B_0) \tag{30}$$

Assume the production functions (14) and (15).

If we further impose the simplifying assumption $\beta = \frac{1}{(1+r)}$, then we can solve for the steady state solution. In steady state the current account is balanced so $b_{t+1} - b_t = 0$ and national saving equal domestic investment. Steady state investment (and saving) is a linear function of government consumption and is given by (see appendix):

$$I^* = S^* = a_0 + (\frac{q-v}{1-qv})a_1 G_T + (\frac{q-v}{1-qv})a_2 G_N \tag{31}$$

where a_1 and a_2 are functions of all the model parameters.

If the tradable sector is more labor intensive than the nontradable sector, the signs of a_1 and a_2 are ambiguous but will in general depend on the relative magnitudes of v and q. If, on the other hand, nontradables are more labor intensive ($v > q$), then a_1 is unambiguously positive and a_2 negative(proof of this is in the appendix). Thus, under the accepted assumption that the nontradable good is more labor intensive, the higher is government consumption of nontradables, the lower will be steady state domestic investment.

We return now to the results of section 2. In addition to the Feldstein-Horioka observations that long run average saving rates differ across countries and saving and investment rates are positively correlated, we noted the following observations: countries with highly volatile saving rates have highly volatile investment rates, long run average saving and current account rates are positively correlated, countries with high long run saving rates tend to have a high proportion of saving flow abroad, and long run government consumption is negatively correlated with both long run saving and long run investment rates.

To compare the model's predictions with these stylized facts we consider a hypothetical global economy consisting of a large number of small national economies identical in every respect except their permanent level of government consumption. Differences in government consumption requirements cause differences in their long run investment. In the stationary equilibrium national saving equals domestic investment so these two are perfectly correlated. Thus, the first two observations emerge naturally as steady state outcomes when government consumption acts as a third factor driving both saving and investment.

For most countries government purchases are heavily weighted with output from the nontradable sector, primarily services. Expenditure on health, education and public order and safety are all large shares of final government spending. If nontradables are relatively more labor intensive to produce, the model predicts a negative correlation between government consumption and investment, which is what we observe in the data.

Because the current account reflects intertemporal trade among countries, a steady state analysis cannot explain the observed correlations between the current account balances and other variables. A stochastic dynamic economy (along the lines of Baxter and Crucini (1990), Finn (1990) or Tesar(1991)) is required to account for these correlations.

6 Conclusion

This paper argued that the Feldstein and Horioka "puzzle" might be explained by the important role government spending plays in the determination of saving, investment and current account behavior. Using an intertemporal equilibrium model it was shown that variation across countries in long run government consumption gives rise to national differences in long run saving and investment and variation in government consumption over time induces comovements over time in saving and investment within a country. The model's qualitative predictions are found to be consistent with a number of empirical observations.

Because these results emerge in an economy with perfect capital mobility, I find that neither of the conclusions reached by Feldstein and Horioka's initial study are justified. In particular, (i) a high cross country correlation between saving and investment rates is perfectly consistent with high capital mobility, and (ii) the observation that long run average saving and investment are equal does not imply that the economy can be treated as closed when making policy. While it is true that countries successful in stimulating savings are likely to significantly increase investment, the type of policies effective in stimulating savings are unlikely to be the same in an open economy as those in a closed. The underlying model must be taken into account when evaluating the effects of any policy decision.

APPENDIX

In this appendix I

(i) derive the steady state solution for the optimization problem given in the section 4.

(ii) demonstrate that steady state domestic investment (and therefore saving) is a linear function of government consumption of tradables and nontradables, and

(iii) show that if the nontradable sector is relatively more labor intensive than the tradable sector ($v > q$), then steady state investment is a decreasing function of government consumption of nontradables and an increasing function of government consumption of tradables.

From section 4 we know that the optimal solution must satisfy the system of equations (26) - (30) and the first order conditions:Ω

$$\frac{U_1(C_{Nt}, C_{Tt})}{U_2(C_{Nt}, C_{Tt})} = \frac{G_2(K_{Tt}, L_{Tt})}{F_2(K_{Nt}, L_{Nt})} \tag{32}$$

$$\frac{U_1(C_{Nt}, C_{Nt})}{\beta U_2(C_{Nt}, C_{Tt})} = F_1(K_{Nt}, L_{Nt}) + (1-\delta) \tag{33}$$

$$\frac{U_2(C_{Nt}, C_{Tt})}{\beta U_2(C_{Nt+1}, C_{Tt+1})} = 1 + r \tag{34}$$

$$\frac{U_1(C_{Nt}, C_{Tt})}{U_2(C_{Nt+1}, C_{Tt+1})} = \frac{U_2(C_{Nt+1}, C_{Tt+1})}{U_1(C_{Nt+1}, C_{Tt+1})} G_1(K_{Tt+1}, L_{Tt+1}) + (1-\delta) \tag{35}$$

First, substitute equations (26) - (29) into equations (30) and (32) - (35). In steady state $C_{Nt} = C_{Nt+1}, C_{Tt} = C_{Tt+1}, K_{Nt} = K_{Nt+1}, K_{Tt} = K_{Tt+1}, L_{Nt} = L_{Nt+1}$ and $L_{Tt} = L_{Tt+1}$. Imposing this, equations (30) and (32) - (35) become:

$$K_T^v(1-L_N)^{(1-v)} - C_T - G_T = \frac{r(-B_o)}{(1+r)} \tag{36}$$

$$\frac{\alpha C_T}{(1-\alpha)(K_N^q L_N^{(1-q)} - \delta K_N - \delta K_T - GN)} = \frac{(1-v)K_T^v(1-L_N)^{(-v)}}{(1-q)(K_N^q L_N^{(-q)}} \tag{37}$$

$$\frac{1}{\beta} = qK_N^{(q-1)}L_N^{(1-q)} + (1-\delta) \qquad (38)$$

$$\frac{1}{\beta} = 1+r \qquad (39)$$

$$\frac{1}{(1-\delta)\beta} = \qquad (40)$$

$$1 + \frac{(1-\alpha)(K_N^q L_N^{(1-q)} - \delta K_N - \delta K_T - GN)(K_N^{(v-1)}(1-L_N)^{(1-v)}v}{\alpha(C_T(1-\delta))}$$

We can solve this system of 4 equations ((39) holds true by assumption) for steady state C_N, K_N, K_T and L_N. From (40) we have

$$C_T = A_0(K_N^q L_N^{(1-q)} - \delta(K_N + K_T) - G_N)K_T^{(v-1)}(1-L_N)^{(1-v)} \qquad (41)$$

where

$$A_0 = \frac{v(1-\alpha)\beta}{(1-\beta+\delta\beta)\alpha} > 0 \qquad (42)$$

Substitute this into equations (36) and (37). The remaining 3 equations can be solved simultaneously as

$$K_N = A_1 L_N \qquad (43)$$

$$K_T = A_1(\frac{(1-q)v}{(1-v)q})(1-L_N) \qquad (44)$$

$$L_N = \frac{1}{A_2}(A_3 - A_4 G_T + A_5 G_N) \qquad (45)$$

where

$$A_1 = [\frac{(1-\beta+\beta\delta)}{\beta q}]^{\frac{1}{(q-1)}} > 0 \qquad (46)$$

$$A_2 = 1 + \frac{(1-\alpha)(1-v)}{\alpha(1-q)}(1-\delta A_1^{(1-q)}(1-\frac{(1-q)v}{(1-v)q})) \qquad (47)$$

$$A_3 = 1 + \frac{\beta v(1-\alpha)\delta}{(1-\beta+\beta\delta)\alpha} - A_4^v(\frac{r(-B_0)}{1+r}) \qquad (48)$$

$$A_4 = (\frac{(1-v)q}{(1-q)v})^v A_1^{-v} \qquad (49)$$

$$A_5 = (\frac{(1-\alpha)(1-v)}{\alpha(1-q)})A_1^{-q} > 0 \qquad (50)$$

Therefore, steady state investment is:

$$I^* = \delta(K_N^* + K_T^*) = \delta A_1(\frac{q-v}{1-qv})L_N^* + \frac{(1-q)v}{(1-v)q} \tag{51}$$

or

$$I^* = a_0 + (\frac{q-v}{1-qv})a_1 G_T + (\frac{q-v}{1-qv})a_2 G_N \tag{52}$$

where

$$a_1 = -\delta A_4 \frac{1}{A_2} \tag{53}$$

$$a_2 = \delta A_5 \frac{1}{A_2} \tag{54}$$

which is equation (31) in the text.

Proposition: if $v > q$, then $A_2 > 0$ and therefore $a_2 > 0$ and $a_1 < 0$.

Proof: Suppose $v > q$, then $1 - \frac{(1-q)v}{(1-v)q} < 0$. $1 - \delta A_1^{(1-q)}(1 - \frac{(1-q)v}{(1-v)q}) > 0$ and $A_2 = 1 + \frac{(1-\alpha)(1-v)}{\alpha(1-q)}(1 - \delta A_1^{1-q}(1 - \frac{(1-q)v}{(1-v)q})) > 0$. Since $A_5 > 0$ and $A_4 > 0$, it follows directly that $a_2 > 0$ and $a_1 < 0$.

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Table 1: Conteporaneous Time Series Correlations

Countries	Corr. S/Y, I/Y	Corr. S/Y, G/Y	Corr. I/Y, G/Y	Corr. BCA/Y,G/Y	Corr. C/Y, G/Y
Canada	0.899	-.687	-.633	.201	-.712
United States	0.753	-.629	-.702	-.067	.108
Japan	0.928	-.864	-.788	.194	.747
Australia	0.593	-.850	-.746	-.563	-.035
New Zealand	0.448	-.564	-.102	-.436	-.536
Austria	0.889	-.791	-.744	-.191	-.034
Belgium	0.883	-.856	-.720	-.758	.422
Denmark	0.945	-.914	-.863	-.500	-.690
Finland	0.693	-.405	-.424	.162	-.684
France	0.946	-.986	-.938	-.553	.948
Germany	0.905	-.919	-.870	-.099	.481
Greece	0.938	-.457	-.504	-.237	-.549
Iceland	0.337	-.683	-.353	-.204	-.581
Ireland	-0.355	-.804	.443	-.678	-.794
Italy	0.483	-.921	-.468	-.409	-.371
Luxembourg	-0.028	.657	-.250	.692	.646
Netherlands	0.855	-.909	-.729	-.059	-.133
Norway	-0.489	-.155	.133	-.239	-.618
Portugal	-0.008	-.797	.242	-.604	.435
Spain	0.697	-.760	-.748	.053	-.774
Sweden	0.914	-.957	-.911	-.512	-.810
Switzerland	0.911	-.828	-.829	.695	.845
Turkey	0.568	.168	-.093	.005	-.567
U.K.	0.503	-.725	-.620	.062	-.775

Table 2: Average Long Run Rates

Countries	S/Y	I/Y	BCA/Y	BCA/S	-BCA/I
Canada	0.222	0.234	-.101	-.042	0.038
	(.016)	(.022)	(.011)	(.051)	(.047)
United States	0.199	0.192	-.001	-.005	0.002
	(.015)	(.012)	(.010)	(.056)	(.053)
Japan	0.342	0.332	0.008	0.024	-.026
	(.031)	(.034)	(.014)	(.042)	(.045)
Australia	0.240	0.264	-.026	-.117	0.099
	(.028)	(.018)	(.019)	(.094)	(.076)
New Zealand	0.216	0.258	-.035	-.169	0.127
	(.026)	(.037)	(.036)	(.160)	(.119)
Austria	0.266	0.274	-.006	-.024	0.022
	(.025)	(.025)	(.012)	(.049)	(.045)
Belgium	0.217	0.213	-.002	-.025	0.015
	(.040)	(.029)	(.022)	(.115)	(.106)
Denmark	0.195	0.222	-.029	-.164	0.138
	(.040)	(.036)	(.012)	(.087)	(.066)
Finland	0.256	0.270	-.017	-.066	0.059
	(.020)	(.031)	(.020)	(.075)	(.066)
France	0.239	0.237	-.006	-.029	0.027
	(.030)	(.024)	(.010)	(.047)	(.044)
Germany	0.256	0.233	0.007	0.028	-.033
	(.027)	(.028)	(.012)	(.047)	(.052)
Greece	0.199	0.260	-.030	-.165	0.122
	(.034)	(.038)	(.020)	(.136)	(.093)
Iceland	0.231	0.269	-.038	-.177	0.131
	(.031)	(.037)	(.040)	(.184)	(.131)
Ireland	0.159	0.254	-.057	-.424	0.213
	(.031)	(.032)	(.042)	(.400)	(.142)
Italy	0.214	0.212	0.002	0.004	-.012
	(.021)	(.022)	(.023)	(.105)	(.105)
Luxembourg	0.452	0.248	0.191	0.388	-.796
	(.118)	(.033)	(.119)	(.169)	(.498)
Netherlands	0.250	0.237	0.013	0.057	-.064
	(.040)	(.014)	(.020)	(.094)	(.096)
Norway	0.279	0.293	-.019	-.078	0.045
	(.021)	(.038)	(.051)	(.198)	(.160)
Portugal	0.158	0.274	-.024	-.249	0.074
	(.049)	(.038)	(.055)	(.433)	(.188)
Spain	0.209	0.231	-.009	-.047	0.037
	(.018)	(.025)	(.018)	(.087)	(.078)
Sweden	0.216	0.220	-.009	-.049	0.043
	(.035)	(.032)	(.016)	(.084)	(.078)
Switzerland	0.308	0.268	0.027	0.091	-.133
	(.025)	(.039)	(.022)	(.078)	(.101)
Turkey	0.177	0.201	-.022	0.129	0.104
	(.018)	(.026)	(.022)	(.122)	(.095)
U.K.	0.196	0.190	-.001	-.006	-.001
	(.014)	(.019)	(.016)	(.085)	(.081)

Standard Deviations are reported in parenthesis

Table 3: Sample Correlation Matrices of Means and Standard Deviations, 23 OECD Countries

	Avg S/GDP	Avg I/GDP	Avg BCA/GDP	Avg BCA/S	Avg BCA/I
Avg S/GDP	1.000	0.611	0.584	0.642	0.609
Avg I/GDP	0.611	1.000	-.113	-.132	-.046
	(3.53)				
Avg BCA/GDP	0.584	-.113	1.000	0.941	0.990
	(3.30)	(-.52)			
Avg BCA/S	0.642	-.132	0.941	1.000	0.922
	(3.84)	(-.61)	(12.79)		
Avg BCA/I	0.609	-.046	0.988	0.922	1.000
	(3.52)	(-.21)	(29.67)	(10.91)	

	SD S/GDP	SD I/GDP	SD BCA/GDP	SD BCA/S	SD BCA/I
SD S/GDP	1.000	0.618	0.304	0.446	0.370
SD I/GDP	0.618	1.000	0.530	0.399	0.531
	(3.59)				
SD BCA/GDP	0.304	0.530	1.000	0.868	0.956
	(1.46)	(2.86)			
SD BCA/S	0.446	0.399	0.868	1.000	0.865
	(2.28)	(1.99)	(8.02)		
SD BCA/I	0.370	0.531	0.956	0.865	1.000
	(1.82)	(2.86)	(14.93)	(7.90)	

T-Statistics are reported in parenthesis.
Luxembourg has been omitted from the sample.

Table 4: Equilibrium Responses to Alternative Government Consumption Patterns when the Intertemporal Elasticity of Substitution is 0

	Reference	G_{N1}	G_{T1}	G_{N2}	G_{T2}
Case 1					
S/GDP	.29	.24	.24	.34	.34
I/GDP	.16	.13	.17	.17	.17
BCA/GDP	.13	.11	.07	.17	.17
Case 2					
S/GDP	.28	.22	.24	.33	.33
I/GDP	.13	.10	.14	.14	.14
BCA/GDP	.15	.12	.10	.19	.19
Case 3					
S/GDP	.30	.26	.26	.35	.36
I/GDP	.15	.12	.17	.16	.16
BCA/GDP	.15	.14	.09	.19	.19

Table 5: Equilibrium Responses to Alternative Government Consumption Patterns when there is Perfect Intertemporal Substitution of Consumption

	Reference	G_{N1}	G_{T1}	G_{N2}	G_{T2}
Case 1					
S/GDP	.33	.43	.23	.33	.33
I/GDP	.17	.17	.17	.17	.17
BCA/GDP	.17	.27	.07	.17	.17
Case 2					
S/GDP	.45	.51	.35	.45	.45
I/GDP	.17	.17	.17	.17	.17
BCA/GDP	.28	.34	.18	.28	.28
Case 3					
S/GDP	.43	.51	.33	.41	.44
I/GDP	.17	.16	.18	.16	.18
BCA/GDP	.25	.34	.15	.24	.26

Table 6: **The Effect of a Rise in Domestic Spending on Saving, Investment and Current Account Rates**

	Value of $1/\gamma$	S/GDP	I/GDP	BCA/GDP
Increase in Current Spending on Nontradables	low	$\downarrow$	$\downarrow$	$\uparrow$ or $\downarrow$
	high	$\uparrow$	$\downarrow$ if $v > q$ $=$ if $v = q$ $\uparrow$ if $v < q$	$\uparrow$
Increase in Future Spending on Nontradables	low	$\uparrow$	$\uparrow$	$\uparrow$
	high	$\downarrow$ $=$ $\uparrow$	$\downarrow$ if $v > q$ $=$ if $v = q$ $\uparrow$ if $v < q$	$\downarrow$ $=$ $\uparrow$
Increase in Current Spending on Tradables	low	$\downarrow$	$\uparrow$	$\downarrow$
	high	$\downarrow$	$\uparrow$ if $v > q$ $=$ if $v = q$ $\downarrow$ if $v < q$	$\downarrow$
Increase in Future Spending on Tradables	low	$\uparrow$	$\uparrow$	$\uparrow$
	high	$\uparrow$ $=$ $\downarrow$	$\uparrow$ if $v > q$ $=$ if $v = q$ $\downarrow$ if $v < q$	$\uparrow$ $=$ $\downarrow$

Table 7: The Model's Predictions of Contemporaneous Correlations when $1/\theta$ is Low

	GOV/Y	S/Y	I/Y	BCA/Y
GOV/Y				
S/Y	-			
I/Y	-	+		
BCA/Y	+ or -	+ or -	+ or -	

Actual Data Contermporaneous Correlation Matrix

	GOV/Y	S/Y	I/Y	BCA/Y
GOV/Y				
S/Y	-			
I/Y	-	+		
BCA/Y	-	+	+	

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